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ABSTRACT

It was hypothesized that the cognitive structures which underlie performance on class-inclusion tasks also underlie reading comprehension of the stated or inferred main idea of a paragraph, and that performance on three-dimensional class-inclusion tasks developmentally precedes performance on two-dimensional class-inclusion tasks. Ten kindergarten through fourth grade students were administered two comprehension tests and eight class-inclusion tasks in the pilot study, which is appended. As a result, the Main Idea Test (MIT) and seven single and double class-inclusion tasks were administered to 267 kindergarten through second grade students. The MIT involves three paragraph types: (1) those with the main idea stated in the first sentence; (2) those with the main idea in the last sentence; and (3) those with the main idea to be inferred by the reader. Each paragraph is followed by a multiple choice question on the main idea. Kindergarten students scored at a chance level on the MIT. Level of class-inclusion was significant for first and second graders. Second graders scored significantly lower on inferred than on stated main ideas. Implications for further research are discussed, and MIT items are appended. (Author/JAC)

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The Relation between Class-inclusion and Reading Comprehension of the Main Idea*

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* This is the final report of this research project which was funded by a grant from the Spencer Foundation.

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Abstract

The hypothesis of this study was that the cognitive structures which underly performance on class-inclusion tasks also underly reading comprehension of the stated or inferred main idea of a paragraph. The Main Idea Test (MIT) and seven single and double class-inclusion tasks were given to 102 kindergarten, 72 first grade, and 93 second grade middle class children. Students were grouped into four groups on the basis of their ability to include. Kindergarten children scored at a chance level on the MIT. Level of class-inclusion was significant for first ($p < .04$) and second ($p < .005$) graders. Second graders scored significantly lower ($p < .04$) on inferred than on stated main ideas. Results and implications for future research are discussed.

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The Relation between Class-inclusion and Reading Comprehension of the Main Idea

Goodman (1970) refers to his model of the proficient reading process as a "psycholinguistic guessing game." Readers recreate the author's meaning by selecting minimal cues from redundant information represented on the printed page. On the basis of their cognitive abilities and knowledge of language readers make predictions about meaning which they confirm or reject by testing for semantic and syntactic acceptability. When predictions are rejected, readers pause or regress to select more cues, revise their predictions and test again for semantic and syntactic acceptability.

Implicit in this model are the following assumptions: (a) that readers bring to the reading task a store of structured information on which the tests for acceptability are based, and (b) that this store continually is restructured as reading progresses. Readers attempt to assimilate in-coming information into existing structures. However, these structures must frequently be modified or reorganized to permit efficient storage of greater quantities of information and to allow for the comprehension of new ideas which do not fit into the existing structures.

Building on the work of Goodman (1970) and Smith (1971), Caldwell (1975) postulated that readers create hierarchical arrangements of ideas, structuring and restructuring the hierarchy as information is incorporated. She suggested that these processes are essential for comprehension of

the main idea of a paragraph. Readers subconsciously ask themselves a series of questions: Is it the main idea? Is it a supporting detail of a main idea yet to be introduced? Is it an irrelevant detail or a writing convention? Questions asked about later sentences are asked in relation to all preceding sentences. When predictions are rejected, readers again pause to reorganize the hierarchy by selecting additional cues.

Both Goodman (1970) and Caldwell (1975) assume that the reader possesses cognitive structures which allow proficient reading comprehension to occur. The question remains, namely, what is the nature of these cognitive mechanisms? This question is even more important to those concerned with the acquisition of proficient reading rather than merely the process of proficient reading. They are concerned with the development of cognition, developing proficiency in reading, as well as the environments which will maximally foster growth in these areas. Therefore, it is important that researchers attempt to uncover the nature of these cognitive structures as they relate to reading comprehension, particularly certain reading tasks such as comprehending the main idea of a paragraph. In this study the hypothesized nature of this relationship was based not only on the work of Goodman (1970) and Caldwell (1975), but also on the theoretical framework of the developmental psychologist, Jean Piaget.

Genetic epistemology (Inhelder, 1977), the proper name for what is often referred to as "Piagetian theory," postulates that it is not the performance of any single task per se, but rather the underlying structures

which are reflected in correct performance on that task and are important in understanding cognitive development. One of the tasks which Piaget, Inhelder, and their colleagues have used to study the growth of logic in children is the class-inclusion task in which children are asked to compare the number of objects in subclass A with the objects in a superordinate class B. For example, children who are presented with five roses (A) and three daisies (A') are asked whether there are more roses (A) or more flowers (B). Piaget and Inhelder's description of the processing necessary for class-inclusion performance is analogous to the processing necessary to comprehend the main idea of a paragraph as described by Caldwell (1975).

Piaget (1975a) defines three elements necessary for understanding the class-inclusion problem. First, in addition to understanding the additive relation of A + A' = B, the children must also be able to use negation. That is, they must understand that group A is composed of those elements of B which are not elements of A' and also that the elements of A' are elements of B which are not elements of A. Negation permits children to quantify the relations between classes and subclasses (i.e., A = B - A' and that A' = B - A). Second, children must have cognitive mobility (i.e., the ability to shift from subclass A to superordinate class B and back again). Third, children must be able to construct multiplicative relations (i.e., maintaining two or more superordinate classes and/or subclasses simultaneously).

Caldwell's description of the processing involved in comprehending the main idea of a paragraph parallels the processing of class-inclusion

tasks. How the reader treats the first sentence of a paragraph depends on his/her experience with finding the main idea which helps the reader set certain expectations. The main idea may be located in the first or last sentence, embedded in the middle of a paragraph (less frequent), or it may be inferred by the reader (Robinson, 1975). The following paragraph can serve as an example in order to describe Caldwell's model (1975) in more detail.

1. Today my father baked a cake. First he put the mix into a bowl. Then he put in some milk and one egg and mixed it. After the cake baked for one hour, Dad said it was done.

Caldwell proposes that the reader processes the first sentence and, unless it is an obvious writing convention, tentatively hypothesizes that this is the main idea. She described this process as the equivalence of creating a set (or superordinate class) with the label "Today my father baked a cake." The next sentence is read and considered. It is compared with the existing "set" in memory. If it is a detail, it can be incorporated within the set which maintains its label. In the first example, the label of the set (or main idea) is retained as each sentence is processed, because each of the remaining sentences can be incorporated as part of the father's cake baking activities.

When the main idea is not directly stated and must be inferred by the reader, the process becomes more complex.

2. The balloons were red and orange. We all played games. Sammy's Mom and Dad made the cake. We had fun watching Sammy open his presents. He liked my present the best. It was a baseball.

Using the same strategy of hypothesizing that the first sentence is the main idea, the reader creates a set and labels it "The balloons were

red and orange." When the second sentence is read, it cannot be incorporated in the originally hypothesized set. Therefore, the reader has several alternative strategies to choose from: (a) to create another set labelled "We all played games," and retain the original set until more information is available, (b) to create the new set and incorporate the first sentence in it, hypothesizing that somehow the balloons were part of the games, or (c) to consider the first two sentences as examples of a new set for which a label must be generated--perhaps "We went to a carnival." As the third sentence is read, the major characters are introduced as well as the concept of "cake." At this point, the reader will probably select the third strategy mentioned above and modify the label to "We went to a party." The concept of "having fun" is added, as well as the concept of "birthday" in the fourth sentence. Consequently, the label is revised again to "We had fun at the birthday party." The last sentences are easily included in this set. Generally, it would seem that main ideas inferred by the reader would be more difficult to comprehend, since at no time are they confimed explicitly in the text.

It is important to note that whether the main idea is stated or inferred,[1] the reader must be able to consider the set (or class) and its parts (subclasses) simultaneously, to move mentally from class to subclass and back again, and to reorganize existing information into new classes with new subclasses--highly reminiscent of the use of negation, cognitive mobility, and construction of multiplicative relations, the essence of class-inclusion performance (Piaget, 1975a). The processing requirements

are similar for both tasks.

Numerous studies (cf. Elkind, Larson, & Van Doorninck, 1965; Gallagher & Reid, 1975; Reid & Reiling, 1976; Wilkinson, Lunzer, & Dolan, 1973) have reported correlations between measures of operativity[2] and reading ranging from .35 to .59. Wilkinson et al. (1973) in that part of their study related to class inclusion, found that classification including class-inclusion, class intersection,[3] and facility with the words all and some, was the best predictor of reading achievement (using several standardized reading tests as measures) in first grade. Their total battery included other tests of Piagetian constructs, learning, language, memory, and divergent productions. The highest correlation was between reading and the class intersection test.

Hathaway and Hathaway-Theunissen (1975) found very high correlations between class-inclusion performance and reading as measured by the California Achievement Test (CAT). For the first graders the correlation for the total reading score was .74, for the vocabulary subtest .79, and for the comprehension subtest .45. All of these correlations were significantly different from zero at the .01 level. The data for the second graders was somewhat less impressive. The correlation between class-inclusion and the total reading score of the CAT was .22 (NS), the vocabulary subtest .22 (NS), and the comprehension subtest .20 (NS).

None of the studies listed above, however, attempted to specify the relation between class-inclusion and a specific reading task. Therefore, the current study postulated that a relation between class-inclusion and comprehension of the main idea existed on the basis of the similar

processing requirements and content demands in these tasks.

The first hypothesis of this study was that comprehension of the main idea of a paragraph should be related to class-inclusion performance, since class-inclusion problems (a) involve cognitive elements similar to those required to determine the main idea of a paragraph, and (b) provide a test of some aspects of the information store which the child brings to the reading situation as background information. Class-inclusion, therefore, appears to be related to reading along both process and content dimensions.

A second hypothesis was also proposed: Inferred main ideas, which are never confirmed by explicit statements in the text, are more difficult to comprehend than main ideas stated in either the first or last sentence of a paragraph.

Methodology

This study was a first attempt to propose and test a theoretical model relating cognitive functioning and comprehension of the main idea in kindergarten, second, and fourth grade children (see Figure 1).

Insert Figure 1 about here

A pilot study was conducted in Spring, 1976. Results tentatively supported the model (see Appendix A for a report of the pilot study). The major study was conducted with some modifications as a result of insights gained from the pilot study. These modifications will be discussed in

each section when appropriate.

Subjects

White, middle class kindergarten, second, and fourth grade children from a public school located on the upper eastside of Manhattan were used as subjects in the pilot study. A ceiling effect was clearly evident in the fourth grade data. Therefore, the target population of the major study was changed to kindergarten, first, and second grades.

Originally, subjects for the major study were to have been drawn from two public schools in Manhattan. Before testing began in Spring, 1976, it was learned that another research project in one of the schools was using a training task which potentially might have affected the results of this study. Consequently, subjects who attended three public schools in a middle class community in New Jersey were used. One hundred twenty children from kindergarten, first, and second grades were randomly selected and tested. Data from children with learning disabilities and those who were not fluent in English were not used in the study. Kindergarten and first grade children who could not label the items in the class-inclusion tasks adequately were eliminated, as were first graders who could not read. The final groups included in the study consisted of 102 kindergarten, 72 first grade, and 93 second grade children.[4]

Materials

Reading/listening tests. Two reading measures were used. First and second graders were given the reading subtests of the Stanford Achievement Test, Primary Levels I and II, Form A, respectively (Madden, Gardner,

Rudman, Karlsen, & Merwin, 1972). Instead of a reading test, the kindergarten children were given the listening subtest of the Stanford Early School Achievement Test, Level I (Madden & Gardner, 1969).

An examination of Reading: Part B of the Stanford Achievement Test forced the authors to construct a Main Idea Test for the following reasons. All items on Reading: Part B, which was designed to test comprehension, resemble a cloze exercise[5] with the blank in place of one of the last few words of the sentence which is the stem of the multiple choice item. Then the reader must select usually one word from three (Primary I) or four (Primary II) alternatives, which are all the same part of speech, to fill in the blank. It is not until the final six items of Primary II, Reading: Part B that the reader is required to process more than two sentences of text. It is even possible that a reader (with a good knowledge base) could complete these items without ever having read the paragraph associated with them. At most, this cloze-type task requires the reader to identify the semantic constraints in a given sentence and, using his/her background of knowledge of vocabulary and word recognition (32 out of 42 of the answers on the Primary I, and 33 out of 48 on the Primary II, Reading: Part B subtests could be selected on the basis of only the initial consonant), select one of three alternates. At no time is the reader asked to read a selection and find the main idea.

The Main Idea Test (MIT) was therefore constructed by one of the authors and her research assistant.[6] It consisted of three sets of three paragraphs: (a) one set with the main idea stated in the first sentence

of each paragraph, (b) one set with the main idea stated in the last sentence, and (c) one set with the main idea to be inferred by the reader. Each paragraph was followed by a multiple choice question on the main idea. A correct answer and three distractors (one incorrect distractor and two stated details from the paragraph) were randomly assigned to one of the four answer positions a, b, c, or d. Only the multiple choice format was used since recall questions had produced erratic responses from kindergarten and second grade children in the pilot study. In the pilot study, the MIT passages were based on the content of the class-inclusion tasks, limiting generalizability and increasing the possibility of an effect due to the similarity in content. Therefore, the content of the MIT passages in the major study was revised so that it differed from the content of the inclusion tasks. Vocabulary in the paragraphs was selected so that concepts would be familiar and easily read by first and second graders.

The reliability of the MIT was estimated from the subject to subject variability according to a procedure developed by Hoyt (1941). The reliability of the MIT for the second graders was .74 and for the first graders was .76. The test has high face validity. The items were constructed according to the format of main idea items found in higher level standardized reading tests. The correlations between Reading: Part B (Stanford Achievement Test) were between .30 and .42 for first and second graders. The low correlation supports the contention that the MIT tapped a different reading ability than the subtest of the Stanford.

Class-inclusion tasks. Both single and double class-inclusion tasks were used according to traditional methodology (Inhelder & Piaget, 1964; Inhelder, Sinclair, & Bovet, 1974). In the single inclusion tasks, the child was presented with five objects or pictures of one subclass (e.g., collies), and three objects or pictures of a second subclass (e.g., boxers), and asked whether there were more collies or more dogs. The 5:3 ratio is consistent with the Ahr and Youniss (1970) finding that greater disparity leads to more errors. The double inclusion tasks required the addition of objects or pictures related to a larger class (C). For example, to the collies and boxers, a cow, a pig, and a lion were added. The child was then asked whether there were more animals (C) or more dogs (B).

Recently, there has been some concern over the effect of content on class-inclusion performance (Carlson & Abrahamson, 1976; Kurtz, 1977; Rosch, 1973). Therefore, a variety of typical and atypical examples were used for the class-inclusion tasks. The content of the tasks is presented in Figure 2.

Insert Figure 2 about here

The pilot study was designed to test whether children would master three-dimensional class-inclusion tasks using objects prior to mastering two-dimensional class-inclusion tasks using pictures, and to see whether this would be related to mastery of reading, another task involving the processing of two-dimensional stimuli. Since there was some evidence in the pilot study to support this model, the four class-inclusion tasks

were each presented using both pictures and objects. The one exception was the "flower" task, which was presented only with objects because pictures of roses and daisies planted in pots (so that they looked like flowering plants) were unavailable. The order of the tasks were randomly assigned for each subject.

An additional task, which was linguistically more complex, was used in the pilot study. Firemen and doctors were introduced as New Yorkers. The child was asked whether there were more New Yorkers or more firemen. A cowboy, and Indian, and a teacher, who were described as coming from places in the United States other than New York, were later introduced as Americans. The child was asked whether there were more Americans or more New Yorkers. Children generally responded that there were "more people" so the task was dropped.

Procedure

Standardized testing. The standardized testing was carried out by the classroom teachers in two schools. The standardized testing in the third school was conducted by one of two white, female research assistants or by one of the female authors. All other testing was conducted by one of the research assistants. Any standardized testing which had to be made up due to pupil absences was conducted by one of the authors. All first and second grade subjects were given the reading subtests of the Stanford Achievement Test.

Main Idea Test. Next, each child was individually administered the MIT followed by the class-inclusion tasks by one of the experimenters. The directions for the MIT were as follows:

> You are going to read some stories. After each story, you will read some sentences. Tell me the sentence which says what the whole story is about. Find the sentence that tells the most important idea about the story. If you don't know a word, point to it and I will tell you what it is. Do you understand the directions? (Repeat if necessary.) Now begin with the first story.

The experimenter had the child read the first sentence of each paragraph aloud to assure reading ability. (For the first grade children who could not read, the MIT was administered as a listening test.) When the child had finished reading a paragraph, the material was turned over to reveal the question sentences for the paragraph. The child was reminded to read the sentences and pick the sentence that says the most about the story. If the child experienced difficulty or was hesitant, the experimenter suggested that s/he read the story again and then find the best sentence about the story.

The kindergarten children were given the MIT as a listening test. A similar procedure was used. The directions were as follows:

> You are going to listen to some stories. After each story you will hear some sentences. Tell me the sentence that says the most about the story. Tell me the sentence which tells you the most important idea about the story. Sometimes when you listen to a story, it's hard to remember. If you can't remember the story tell me and I will read it again for you. If you can't remember the sentences, tell me and I will read

the sentences again for you. Do you understand the directions? (Repeat if necessary.) Here is the first story.

If the child seemed hesitant or had difficulty, the experimenter asked if s/he would like her to read the story (sentences) again.

Class-inclusion tasks. Following the MIT, the class-inclusion tasks were administered to the child individually by one of the experimenters. First, the child was asked to name all of the individual items and groups of items. If a child were unable to apply a superordinate term, s/he and the experimenter searched for a term that they could both agree to use. Inhelder, Sinclair, and Bovet (1974) found no differences in the class-inclusion performance of those children who initially supplied the superordinate term and those who did not. (If a child could not name the items or could not settle on a mutually agreed upon superordinate term, s/he was eliminated from the study.) The class-inclusion tasks were initially randomized and then varied in order of presentation following a Latin Square Design. The following questions (Inhelder, Sinclair, & Bovet, 1974) were asked in the same order for a single inclusion task. (In this example, five collies and three boxers are displayed.)

1. Are there more collies or more dogs? How do you know? More (dogs, collies) than what? If the child answered "more than boxers," s/he was asked to repeat the question. If the repetition was incorrect, the experimenter asked the correct question again.

2. If I give you the collies, what will I have left?

3. If I give you the dogs, what will I have left?

A child had to respond correctly to all of the above and provide a correct explanation in order to be considered successful (a score of 1) on the single inclusion problem (failure was scored as 0). Immediately following the presentation of the single inclusion problem, the double inclusion problem task was presented. The following questions were asked. (In this example, a cow, a pig, and a lion are added to the display.)

1. Are there more dogs or more animals? How do you know?
2. Are there more dogs or more collies? How many more?

Again, the child had to answer both sets of inclusion questions and give a correct explanation to be considered a successful double includer (score of 2). A child who answered only question two received a score of 1. A child who failed both question received a score of 0.

Results

The proposed model (see Figure 1) was analyzed using standard path analysis techniques (Kerlinger & Pedhazur, 1973; Li, 1975). The high correlation between the class-inclusion tasks using objects and pictures (.97 for the second grade, .92 for the first grade, and .86 for the kindergarten) indicated that the two tasks measured the same cognitive ability and could not be treated as dictinct, measurable constructs. In addition, the hypothesized zero path between class inclusion of object and comprehension of the main idea did not exist. The correlation between these variables was .40 for the second grade and .24 for the first grade. Both values were significantly different from zero. On the basis of these results, the model could not be shown to be valid. (Full correlation matrices for each grade are included in Appendix C.) The above

analysis was repeated with the data segregated by sex. However, the results were not appreciably different.

In order to determine the relationship between class-inclusion ability and reading comprehension as measured by the MIT or the Stanford Reading: Part B, plots of the variables were examined. These plots indicated the expected distinct grouping of students on class-inclusion ability (Inhelder, Sinclair, & Bovet, 1974). On this basis, the second grade students were placed into one of four groups: nonincluders (NIs), transitional children who performed successfully on some single inclusion tasks (TIs), children who successfully completed the single inclusion tasks (SIs), and children who successfully completed the double inclusion tasks (DIs). First grade students fell primarily into three groups (NI, TI, and SI).[7] Preliminary analyses of variance indicated there were no sex differences. Consequently, further analyses did not consider sex as a variable.

A repeated measures analysis of variance was performed for Level of inclusion (NI, TI, SI, or DI), Type of main idea sentence (first, last, or inferred) blocked for subjects (Winer, 1971). Separate analyses were performed for first and second grade data. Kindergarten data were not analyzed since the scores were at a chance level on the MIT. The ANOVA table for the second grade is presented in Table 1.

Insert Table 1 about here

The means for the second graders are presented in Table 2.

Insert Table 2 about here

The main effects for both Level (of inclusion) and Type (of main idea) were significant at $p < .005$ and $p < .01$, respectively, with respect to the MIT. Scheffé post hoc analysis of the means revealed that NIs differed significantly from DIs. TIs and SIs did not differ from each other, nor did they differ from the NIs or DIs. A Scheffé post hoc analysis showed that stated main ideas were significantly easier to comprehend than inferred main ideas for second graders. The interaction term was not significant.

A repeated measures analysis of variance was also used to examine the first grade data. The analysis of variance table is presented in Table 3. The means are displayed in Table 4.

Insert Tables 3 and 4 about here

There was a significant main effect for Level (of inclusion). A Scheffé post hoc analysis indicated that NIs scored significantly lower ($p < .04$) than the SIs on the MIT. However, the TIs did not differ from either of the other groups.

A secondary analysis was performed using Reading: Part B as the dependent variable. Since Reading: Part B and the MIT were not highly correlated, the question remained whether these two reading "comprehension"

tasks share a similar cognitive base. A two-way ANOVA with Level of Inclusion and Sex and the independent variables was performed for first and second grade. No significant results were obtained. (See Tables 5 and 6.)

Insert Tables 5 and 6 about here

Discussion: Part I

The proposed model relating class-inclusion and reading comprehension was not supported by the data for two reasons: (a) a very high correlation existed between two- and three-dimensional class-inclusion, and (b) a statistically significant relationship existed between two-dimensional inclusion and reading. Clearly, mode of presentation had no effect on the class-inclusion performance of the children in this study. This finding may be of interest to Piagetian researchers, since in many situations pictures are more easily obtained and used than objects.

In order to test a model by means of PATH analysis, a zero path must exist within the model which allows for the test of direction or causality (Kerlinger & Pedhazur, 1973). In the pilot study, the critical path was spuriously supported, probably by the strong effect of the Grade variable. In the major study, however, separate analyses were performed on the data for each grade. Not only did the distinction between two- and three-dimensional tasks fail to receive support, but

also a relationship existed between class-inclusion and reading, the hypothesized zero path. In conclusion, the testing of a causal model seems in retrospect somewhat premature.

However, a relationship between class-inclusion and reading comprehension of the main idea did exist. After examining a plot of the data, the authors realized that an analysis of variance was needed to analyze the data due to the distinct grouping of the data. The pattern of the grouping was consistent with the work reported by the Genevans (Inhelder, Sinclair, & Bovet, 1974), who noted that class-inclusion generally leads to right or wrong answers or hesitations, but not to compromise solutions. They further reported that inconsistent or transitional responses are often difficult to detect. Perhaps the traditional tasks used in the present study are not sufficiently sensitive to distinguish performance along a true continuum. This raises an important issue for future research concerning the inappropriate use of correlation to analyze nonlinear class-inclusion data. Perhaps the results of past studies should be re-examined in light of this finding.

Discussion: Part II

Nearly all children who succeeded with the double inclusion tasks also performed successfully on the single inclusion problems. The reverse was not true. The early work of Inhelder and Piaget (1964) involved single, double, triple, and even more complex inclusions. For both bead and flower tasks those authors reported that children approximately 8 years old could both "classify correctly in the form

of additive groupings . . . (and) recognize the inclusions implied by that structure (A + A' = B; B + B' = C; C + C' = D)" (p. 109). They further suggested a time lag in the ages at which children succeeded on a double inclusion task similar to the one used in this study using animals (i.e., ducks, chickens, birds, and other animals). The age at which this double inclusion was achieved was as late as 13 or 14 years old.

In their later report of training studies, Inhelder, Sinclair, & Bovet (1974) suggested that class-inclusion constitutes a general logical structure. Although their training procedure was limited to single inclusions, they chose to use a double inclusion task (3 dachshunds, 2 Alsatians, 1 cow, 1 pig, and 1 goat) in their posttest (p. 177). They argued that this task required to use a "similar, although more extensive, mental structure" (p. 177) than the single inclusion flower task (daisies and roses) used in their pretest. They further reported successful inclusion behavior--even with animals--among 8 and 9 year olds, as did Piaget (1975). It is important to note, however, that the criterion used to distinguish includers from non-includers in the Inhelder, Sinclair, and Bovet study (1974, p. 181) was successful performance on the single inclusion task. The number of children who succeeded or failed the double inclusion task was not reported. Nearly all other research (cf. Carson & Abrahamson, 1976; Hathaway & Hathaway-Theunissen, 1975; Wilkinson et al., 1973) has studied children's responses on the single inclusion problem.

In the present study, no kindergarten, 2 first grade, and only 11 second grade children were able to complete the double inclusion problem successfully. Since class-inclusion is, like other measures of operativity, considered "a very general logical structure" (Inhelder, Sinclair, & Bovet, 1974, p. 171), one must question whether children successful on only the single inclusion problem are, in fact, includers. The mobility needed to shift criteria (e.g., from collies to dogs to animals) and the understanding of simultaneity (e.g., that collies are simultaneously collies, dogs, and animals) seem to be limited in their application for single includers. Perhaps there is a time lag or a developmental complexity within the inclusion task itself, much as in conservation. One question raised by this study, therefore, is whether there is indeed a hierarchy of complexity within class-inclusion which is related to the level of "embeddedness" of the inclusions.

The performance of both first and second grade students across varied contents on the class-inclusion tasks were nearly identical. Previous research (Carson & Abrahamson, 1976; Rosch, 1973) has suggested that the use of atypical exemplars (e.g., ducks and other birds rather than mammals in the category of animals) confounded semantic problems with the requirements of the class-inclusion task. The work of Saltz, Soller, and Sigel (1972) has shown that children often fragmented adult concepts and applied the superordinate label only to the core (typical) instances. When children were asked whether there were more birds or more animals, this reasoning would predict that they would have responded "more birds" more frequently than "more dogs" in the second animal task.

This prediction was not supported by the finding of the present study. Perhaps, as Inhelder, Sinclair, & Bovet (1974) suggest, "lack of lexical knowledge can no more explain such behavior than lack of perceptual discrimination. The real difficulty lies in the mental operations necessary to establish . . . inclusive relationships" (p. 197). Content, therefore, appears not to have affected performance. It must be noted, however, that the class-inclusion measures used in this study were not sufficiently sensitive to detect content effects where they might have been expected among the transitional children (Kurtz, 1977).

Discussion: Part IIIa

The results of this study also indicate that performance on class-inclusion and comprehension of the main idea from a paragraph share certain underlying cognitive structures. In the second grade, the double includers did not differ from each other nor from the two extreme groups. There was a striking parallel in the first grade data, even though the double inclusion level was excluded from the analysis. Single includers scored significantly higher than nonincluders on the MIT. Again, the transitional group did not differ from either the single includers or the nonincluders. These data suggest that the difference between the performance of the first graders on single inclusion and of the second graders on double inclusion may be attributed to a time lag or delay in the application of the logical operation to more complex problems. Somewhat unexpected by the authors was the lack of significant differences for the transitional groups from the

extreme groups. Perhaps this was due to the great amount of subject to subject variability on the MIT in the transitional group. Only future research will be able to clarify this issue.

Discussion: Part IIIb

It is important to note that a significant difference existed only with respect to the Main Idea Test and not with respect to Reading: Part B of the Stanford Achievement Test for both first and second graders. One interpretation is that Reading: Part B measures a difference aspect of reading comprehension at the word or sentence level and perhaps does not require to integrative thinking which is required by finding the main idea of a paragraph (Caldwell, 1975). This finding supports the authors' contention that there is a need to understand more about the cognitive processes which underly specific reading tasks. Carroll (1972) cited five factors from Davis' factor analytic study (1968) which account for most of the variance of reading comprehension: "remembering 'word' meanings, following the structure of a passage, finding answers to questions answered explicitly or in a paraphrase, recognizing a writer's purpose, attitude, tone, and mood, and drawing inferences from content" (Carroll, 1972, p. 2). Which of these five factors are being measured by the MIT? Do all five factors share the same cognitive structures? Currently, the results of many different kinds of reading "tasks" purport to measure "reading comprehension." It is important that future reading research begin to attempt to define and specify what each "task" is measuring and what cognitive abilities underly performance on those tasks. The second grade data provides some evidence that

suggests that inferential main ideas are more difficult to comprehend than stated main ideas. This finding is consistent with the Caldwell model (1975) which predicts that inferred main ideas will be more difficult because they can never be verified or confirmed by a sentence in the text. It is also consistent with the distinction made in most taxonomies of comprehension skill, old and new (cf. Gray, 1960; Clyner, 1968; Pearson, 1977) that differentiate between questions which can be answered by explicitly stated material in the text (usually referred to as literal comprehension) and those which must be answered by drawing on background information (usually referred to as interpretive or inferential comprehension).

Discussion: Part IV

A few final comments need to be made concerning sample characteristics. Hooper, Swinton, and Sipple (1976) reported female superiority on class-inclusion tasks in their study. No such effect was found in this study or the pilot study. Girls also did not score significantly higher in reading ability, a somewhat unexpected finding, since most studies on reading demonstrate the superiority of girls reading in the early grades (Heilman, 1973, pp. 32-39). The effect of sex on class-inclusion should be explored further. Perhaps there is an interaction with certain environmental variables such as socio-economic status which might help to explain the lack of consistency in the findings. In addition, the population of the pilot study from the upper eastside of Manhattan outperformed their couterparts in the major study. Inhelder, Sinclair, and Bovet (1974) reported that children from a

middle class background performed in a superior way when compared to children from a "less privileged" background. This is one possible explanation of the difference between the pilot and major study, particularly the lack of reliable data for the kindergarten group. Clearly, the role of environmental variables in relation to class-inclusion performance should be more closely studied.

Even though one type of main idea structure is more difficult to process than others, there was no interaction with the class-inclusion variable, again suggesting a common underlying cognitive base for comprehension of both types of main ideas (stated and inferred) as well as for class-inclusion.

Discussion: Part V

Genetic epistemology may provide a rich framework for reading research, particularly in view of the current controversy whether the message communicated exists in the print or in the reader's interpretation of the print (see Carroll & Freedle, 1972). Piaget (1975b), being neither an maturationalist nor an environmentalist, can help us focus on the interaction between the reader and the print. A Piagetian perspective promises to enrich our understanding of how the reader constructs the message from the print by using both his/her own experience, language, expectations, and constraints imposed by the author, and how this process changes from the beginning through the later stages of reading.

Future research should explore the following areas. First, relatively little is known about early reader's cognitive abilities or their

ability to comprehend what they read. The relation between cognitive abilities and comprehension in 3 and 4 year old readers should be examined to determine whether cognitive abilities are prerequisite or simply develop simultaneously with reading ability. Second, Piaget posits that the young child is unable to decenter. One of the tasks measuring degree of decentration is the mountain task which forces the child to take the point of view of someone else. To what extent does the ability to decenter (or lack of it) relate to the reader's ability to detect author's intention, style, or bias? Third, as mentioned before, there was some indication that a hierarchy of complexity may exist within a class-inclusion task. To what extent would double or triple inclusions relate to the ability of third and fourth graders to comprehend the main idea of a paragraph? Does success on increasingly complex inclusion tasks parallel success in comprehending the main idea of longer, more complex material? How does content effect this relationship?

When a new theoretical perspective is adopted, there is often an inherent danger involved. With a particular perspective come certain experimental tasks. The danger lies in premature conclusions imputing causality. This, in turn, leads to the teaching of the particular developmental task. Piagetian research is no exception (Wolff, 1975). The class-inclusion task and its theoretical rationale should continue as a useful experimental tool to explore children's ability to include. The results of this study should in no way be construed as a mandate

to teach the task. In fact, class-inclusion represents the development of a very general structure which cannot be imparted by practice in tasks of classifying. Onyl through careful research will researchers begin to gain insights about the causal elements which influence human behavior.

References

Ahr, P., & Youniss, J. Reasons for failure on the class-inclusion problem. Child Development, 1970, 41, 131-143.

Blalock, H. M. (Ed.) Causal models in the social sciences. Chicago: Aldine Press, 1971.

Caldwell, P. Perceptual and cognitive processes in reading: Analysis of the construction of a main idea statement. Paper presented at the Twentieth Annual Convention of the International Reading Association, New York, May, 1975.

Carroll, J. B., & Freedle, R. O. (Eds.) Language comprehension and the acquisition of knowledge. New York: V. H. Winston & Sons, 1972.

Carroll, J. B. Defining language comprehension: Some speculations. In J. B. Carroll & R. O. Freedle (Eds.), Language comprehension and the acquisition of knowledge. New York: V. H. Winston & Sons, 1972.

Clyner, T. What is reading? Some current concepts. In H. M. Robinson (Ed.), Innovation and change in reading instruction. Chicago: National Society for the Study of Education, 1968.

Elkind, D., Larson, M., & Van Doorninck, W. Perceptual decentration, learning, and performance in slow and average readers. Journal of Educational Psychology, 1965, 56, 50-56.

Gallagher, J. M., & Reid, D. K. To relate or to discriminate: That is the question. Paper presented at the Annual Meeting of the Jean Piaget Society, Philadelphia, June, 1975.

Goodman, K. Reading: A psycholinguistic guessing game. In H. Singer & R. Ruddell (Eds.), Theoretical models of the reading process. Newark, Delaware: International Reading Association, 1970.

Gray, W. S. The major aspects of reading. In H. M. Robinson (Ed.), Sequential development of reading abilities. Supplementary Educational Monographs No. 90. Chicago: University of Chicago Press, 1960.

Hathaway, W. E., & Hathaway-Theunissen, A. The unique contributions of Piagetian measurement to diagnosis, prognosis and research of children's mental development. In G. I. Lubin, J. F. Magary, & M. K. Poulsen (Eds.), Piagetian theory and the helping professions. Los Angeles: University of Southern California, 1975.

Heilman, A. Principles and practices of teaching reading (3rd ed.). Columbus, Ohio: Charles E. Merrill Publishing Co., 1972.

Hoyt, C. Test reliability estimated by analysis of variance. Psychometrika, 1941, 6(3), 153-160.

Inhelder, B., & Piaget, J. The early growth of logic in the child. New York: W. W. Norton & Co., 1964.

Inhelder, B., Sinclair, H., & Bovet, M. Learning and the development of cognition. Cambridge, Mass.: Harvard University Press, 1974.

Inhelder, B. Genetic epistemology and developmental psychology. In R. W. Rieber & K. Salzinger (Eds.), The roots of American psychology: Historical influences and implications for the future. New York: Annals of the New York Academy of Sciences, Vol. 291, 1977.

Kerlinger, F., & Pedhazur, E. Multiple regression in behavioral research. New York: Holt, Rinehart & Winston, 1973.

Li, C. C. Path analysis--A primer. Pacific Grove, Cal.: Boxwood Press, 1975.

Madden, R., & Gardner, E. F. Stanford Early School Achievement Test. New York: Harcourt Brace Jovanovich, Inc., 1969, Level I.

Madden, R., Gardner, E. F., Rudman, H. C., Karlsen, B., & Merwin, J. C. Stanford Achievement Tests. New York: Harcourt Brace Jovanovich, Inc., 1972, Primary Levels I & II, Form A.

Pearson, P. D. Operationalizing terms and definitions in reading comprehension. Paper presented at the Twenty-second Annual Convention of the International Reading Association, Miami, Florida, May, 1977.

Piaget, J. L'Equilibration de structures cognitives. Paris: Presses Universitaires de France, 1975. (a)

Piaget, J. From noise to order. Urban Review, 1975, 8, 207-218. (b)

Piaget, J. Piaget's theory. In P. H. Mussen (Ed.), Carmichael's manual of child psychology. New York: Wiley, 1970, pp. 703-732.

Reid, D. K., & Reiling, A. Toward creative research in reading. Symposium (with J. M. Gallagher, G. Moore, & M. A. Pulaski) presented at the Annual Meeting of the Jean Piaget Society, Philadelphia, June, 1976.

Smith, F. Understanding reading. New York: Holt, Rinehart & Winston, 1971.

Wilkinson, J. E., Lunzer, E. A., & Dolan, T. Mini-symposium: Cognitive development--Internal and external determinant factors affecting cognitive behavior of children in their first year of schooling.

Paper presented at the International Society for the Study of Behavioral Development, Ann Arbor, Michigan, 1973.

Winer, B. J. Statistical principles in experimental designs (2nd ed.). New York: McGraw-Hill Book Co., 1971.

Wolff, P. H. What Piaget did not intend. In G. I. Lubin, J. F. Magary, & M. K. Poulsen (Eds.), Piagetian theory and the helping professions. Los Angeles: University of Southern California, 1975.

Footnotes

[1]In this study there will be three types of main ideas in paragraphs: (a) a stated main idea in the first sentence, (b) a stated main idea in the last sentence, and (c) a main idea which must be inferred by the reader, which will be called an inferred main idea to stress the process used by the reader.

[2]Measures of operativity include tests of transitivity, coversation, and seriation, as well as class-inclusion. Operativity is a broad term which refers to both the set of all actions and operations. "Operations are interiorized actions . . . that are reversible . . . and constitute set-theoretical structures" (Piaget, 1970, p. 705).

[3]The class intersection test measured children's ability to determine which items belonged to both sets such as red squares and geometric figures of all colors.

[4]Forty-two kindergarten, first, and second grade protocols were stolen from one of the research assistant's cars.

[5]The cloze procedure is a method for measuring reading comprehension. The reader is required to fill in every nth word of a passage which has been deleted.

[6]The authors wish to thank Judith Greenwald for her assistance in the construction of this test.

[7]Only two subjects fell into the fourth cell, not adequate for the analysis. Therefore, the fourth level was dropped from the analysis.

Table 1

Class-inclusion and Type of

Main Idea ANOVA for Second Graders

	df	SS	MS	F	p
Level	3	17.85	5.95	4.32	.005
Type	2	4.47	2.23	4.41	.013
Level x Type	6	1.75	.29	.57	.750
Student (Level)	89	122.53	1.38	-	-
Student (Level) x Type	177	89.72	.51	-	-
Total	277	236.32			

Table 2

Level of Inclusion by Type of Main Idea;

Table of Means for Second Graders[a]

	Level of Inclusion				
Type of Main Idea	NI	TI	SI	DI	$\bar{X}$
First	1.90	2.39	2.33	2.73	2.20
Last	2.05	2.13	2.28	2.82	2.20
Inferred	1.66	2.04	2.17	2.36	1.93
$\bar{X}$	1.87	2.19	2.26	2.64	
$\underline{n}$	41	22	18	11	

[a] $\underline{n} = 93$

Table 3

Level by Type ANOVA for First Graders

	df	SS	MS	F	p
Level	2	13.88	6.94	3.16	.04
Type	2	1.60	.80	1.16	.31
Level x Type	4	1.76	.44	.64	.63
Student (Level)	66	118.73	1.80	-	-
Student (Level) x Type	131	90.12	.69	-	-
Total	205	226.10			

Table 4

Level of Inclusion by Type of Main Idea;

Table of Means for First Graders[a]

	Level of Inclusion			
Type of Main Idea	NI	TI	SI	$\bar{X}$
First	1.67	1.71	2.44	1.78
Last	1.59	1.86	2.33	1.77
Inferred	1.32	1.86	2.11	1.59
$\bar{X}$	1.52	1.81	2.30	
$\underline{n}$	39	21	9	

[a] $\underline{n} = 72$

Table 5

Analysis of Variance for Stanford Reading Tests:

First Grade

Source	df	SF	MF	F	p
Total	68	50559.77	-	-	-
Level	2	4108.70	2054.35	2.82	.07
Sex	1	239.78	239.78	.33	.56
Level x Sex	2	240.30	120.15	.16	.84
Error	63	45970.99	729.70	-	-

Table 6

Analysis of Variance for Stanford Reading Tests:

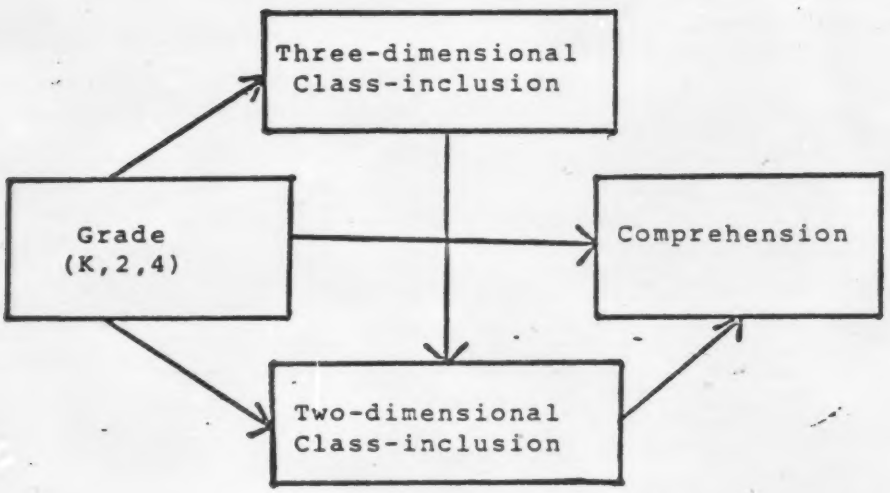
Second Grade

Source	df	SF	MF	F	p
Total	92	29870.99	-	-	-
Level	3	2262.82	754.27	2.45	.07
Sex	1	11.16	11.16	.04	.84
Level x Sex	3	510.41	170.14	.55	.65
Error	85	26186.58	308.08	-	-

Figure Captions

Figure 1. Hypothesized model of the relations between grade, three-dimensional inclusion, two-domensional inclusion, and comprehension.

Figure 2. Class-inclusion tasks.


Three-dimensional
Class-inclusion
Grade
(K,2,4)
Comprehension
Two-dimensional
Class-inclusion

Single Inclusion	Double Inclusion
5 roses + 3 daisies = flowers (presented in small flower pots)	flowers + ivy, fern, cactus = plants (in pots)
5 apples + 3 oranges = pieces of fruit	fruit + 1 hot dog, 1 meat chop, and 1 ice cream cone = food
5 collies + 3 boxers = dogs	dogs + 1 cow, 1 pig, and 1 lion = animals
5 ducks + 3 chickens = birds	birds + 1 fish, 1 horse, and 1 sheep = animals

Appendix A

COGNITIVE PREREQUISITES OF READING COMPREHENSION

(Pilot Study)

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Abstract

A model in which it was hypothesized that the cognitive structures which underly the ability to perform Piagetian class-inclusion tasks also underly reading comprehension was tested by means of path analysis. It was also proposed that performance on three-dimensional class-inclusion tasks would developmentally precede performance on two-dimensional class-inclusion tasks. Five male and five female children from kindergarten, second and fourth grade were individually given two comprehension tests and eight class-inclusion tasks in a pilot study. Results tentatively supported the model, and provided justification for a large-scale study which is currently being done to provide additional data.

Cognitive Prerequisites of Reading Comprehension

Goodman (1970) refers to his model of the proficient reading process as a "psycholinguistic guessing game." Readers recreate the author's meaning by selecting minimal cues from redundant information represented on the printed page. On the basis of their cognitive abilities and knowledge of language readers make predictions about meaning which they confirm or reject by testing for semantic and syntactic acceptability. When predictions are rejected, readers pause or regress to select more cues, revise their predictions and test again for semantic and syntactic acceptability.

Implicit in this model is 1) that readers bring to the reading task a store of information on which the tests for acceptability are based and 2) that this store continually is restructured as reading progresses. Readers attemtp to assimilate in-coming information into existing structures. However, these structures must frequently be modified or reorganized to permit efficient storage of greater quantities of information and to allow for the comprehension of new ideas which do not fit the existing structures.

Using a model similar to the Goodman model, Caldwell (1975) proposed that readers create hierarchical arrangements of ideas, structuring and restructuring the hierarchy as information is incorporated. She suggested that these processes are essential for comprehension of the main idea of a paragraph. Readers subconsciously ask themselves a series of questions: Is it the main idea? Is it a supporting detail of a main idea yet to be introduced? Is it an irrelevant detail or a writing convention? Questions asked about later sentences are asked in relation to all preceeding sentences. When predictions are rejected, readers again pause to reorganize the hierarchy by selecting additional cues.

Researchers who are concerned with the acquisition of the proficient reading process as it is described by Goodman and Caldwell must study the cognitive functions assumed by them which permit proficient reading to occur. The hypothesis of the current study was that cognitive structures which underly the ability to perform class-inclusion tasks (Piaget, 1975) also underly reading comprehension, particularly understanding the main idea of a paragraph.

In the class-inclusion problem children are asked to compare the number of objects in a subclass A with the objects in a superordinate class B. For example, children who are presented with five roses (A) and three daisies (A') are asked whether there are more roses (A) or more flowers (B).

Piaget (1975) defines three elements necessary for understanding the class-inclusion problem. First, children must comprehend negation (i.e., not only that A + A' = B but also that B - A = A', the class of non-roses) so that comparisons between the whole and its parts become possible. Second, children must have cognitive mobility (i.e., the ability to shift from subclass (A) to superordinate class (B) and back again). Finally, children must be able to construct multiplicative relations (i.e., to maintain two or more classes and/or subclasses simultaneously). Ability to perform class-inclusion problems is developmental.

Clearly, proficient reading requires the comprehension of the relations between the superordinate or main idea and the details, the ability to consider these relations simultaneously and to shift from one set of criteria to another. Reading, however, necessarily requires processing of two-dimensional stimuli as opposed to the three dimensional objects generally used in class-inclusion tasks. Finally, achievement of proficiency in both reading and class-inclusion is developmental.

Numerous studies (cf. Gallagher & Reid, 1975; Hathaway, 1972; Reid & Reiling, 1976) have reported correlations between measures of operativity and reading ranging from .35 to .59 (Wilkinson et al., 1973). The highest overall correlation (.74) was obtained between class-inclusion tasks and reading (Hathaway, 1972). Few investigators, however, have attempted to specify the cognitive prerequisites which are necessary for performance of specific comprehension skills (in this case comprehension of the main idea), nor have investigators attempted to propose and test a theoretical model relating cognitive prerequisites to reading comprehension.

Method

In order to test the theoretical model that competence in class-inclusion has a causal relation to reading comprehension and specifically to comprehension of the main idea, a path analytic model (See Figure I) was used to test the following hypotheses: 1) Grade affects comprehension directly. 2) Grade also affects comprehension through the inclusion of three-dimensional objects, but only when inclusion of two-dimensional stimuli (pictures) is also achieved. 3) Grade, therefore, would also influence reading indirectly through class-inclusion of two dimensional pictures.

Insert Figure I about here

Subjects

Thirty children were selected in a stratified random sample from three grades in two urban, public elementary schools for this pilot study. Five males and five females from kindergarten, second and fourth grades were given a standardized test of reading comprehension, a five paragraph reading test on comprehension of the main idea and eight inclusion tasks.

Materials

The eight class-inclusion tasks consisted of four tasks with objects and four tasks with identical content but utilizing photographs as stimuli. Single and double inclusions were used (e.g., five collies and three boxers were presented and the standard questions [Inhelder & Piaget, 1964; Inhelder, Sinclair & Bovet, 1974] were asked regarding collies and dogs. A goat, a cow, and a fish were then added to the collection and questions were addressed to dogs and animals).

The Main Idea Test (MIT) consisted of five one-paragraph stories of approximately one hundred words, based on the content of the inclusion tasks. Vocabulary and syntactic structures were designed to be easily read by a second grade student. The children were asked to read the story and told that they would be asked questions about the main idea of the story when they finished reading. They were told that if they had any trouble reading a word, they should point to the word and the experimenter would pronounce the word for them. After reading a story silently, the children were asked to tell the experimenter the main idea and then asked to respond to a multiple choice question on the main idea. The procedure for the kindergarten children was slightly different. Instead of reading the kindergarteners listened to the stories and answered the questions orally. In order to minimize a reliance on memory, any child could ask to have the story reread. In the reading task the children could refer back to the text. The comprehension subtest of the Stanford Achievement Test for the appropriate grade level (Form A) was also administered to the second and fourth graders. The kindergarten children were given the comprehension subtest of Primary I, Form A as a listening test.

For the 30 students tested, there was no significant difference between single- versus double-inclusion tasks in regard to the difference between two- and three-dimensional class-inclusion task performance t (29) = 1.41; n.s. Since there was no significant difference, the following analysis was done on double-inclusion task performance only. The Stanford comprehension subtest was used as the dependent measure. The correlation matrix for Grade, Two-dimensional Inclusion, Three-dimensional Inclusion and Comprehension is presented in Table I. The correlations are all statistically significantly different from zero ($p < .01$).

Insert Table I about here

A path analysis[1] was conducted based on the model pictured in Figure I. The path coefficients for Figure I are presented in Table II. There is very close agreement between these and the original correlation coefficients. This agreement indicates that Figure I is a good representation, confirming the original hypotheses.

Table III indicates the portion of the correlation coefficient attributable to direct and indirect causes. The zero indirect correlation between

---

Insert Table II about here

Grade and Three-dimensional Inclusion is an assumption necessary for the analysis. The stronger direct relationship to reading is seen to be Grade.

---

[1]For references on this technique see Blalock, 1971; Kerlinger & Pedhazur, 1973; Li, 1975)

The relation between Two-dimensional Inclusion and reading is stronger in an indirect form than a direct form. This indicates a possible theoretical discrepancy, but could possibly be attributed to sampling error. The relationship between Grade and Two-dimensional Inclusion shows almost equal apportionment in the direct and indirect (through Three-dimensional Inclusion) path.

An analysis similar to the above was conducted using the Main Idea Test data in place of the Stanford data. Results while supportive were not as strong as previously recorded. Perhaps, the large standard error of the Main Idea Test masked the effect of the factors in the model.

Caution in the interpretation of these results must be advocated, since the number of children was small and also since the correlations involving the grade factor may make the paths spurious (i.e., that the correlations are really attributable to Grade alone). It is important to note, however, that, as anticipated, a) the grade factor influenced reading through the Two-dimensional task and b) the grade factor influenced reading through the Three-dimensional Inclusion task only by virtue of its relation to the Two-dimensional task.

The authors interpreted the results as promising, however, and are currently conducting a large-scale study in which data from 120 children from each of the three grades (kindergarten, first and second) will be included. To avoid spurious correlations data from each grade will be analyzed separately. Since children will be from a more homogeneous grade group (K-1-2) than those included in the pilot study, the tapping of class-inclusion structures which lack consolidation may lead to more interesting results concerning single and double inclusions as well as two- and three-dimensional tasks.

Table I

Correlation Matrix of Variables

	1	2	3	4
1	1.000	.724	.742	.775
2		1.000	.825	.626
3			1.000	.693
4				1.000

1 Grade
2 Three-dimensional Inclusion
3 Two-dimensional Inclusion
4 Comprehension

Table II

Path Coefficient for Figure I

	1	2	3	4
1	1.000	.724	.742	.744
2		1.000	.825	.605
3			1.000	.655
4				1.000

1 Grade
2 Three-dimensional Inclusion
3 Two-dimensional Inclusion
4 Comprehension

Table III

Contributions to Variance by Direct and Indirect Paths

Path	Direct	Indirect
Grade to Three-dimensional Inclusion	.724	.000
Grade to Two-dimensional Inclusion	.304	.437
Grade to Comprehension	.574	.201
Three-dimensional Inclusion to Two-dimensional Inclusion	.604	.221
Three-dimensional Inclusion to Comprehension	.000	.626
Two-dimensional Inclusion to Reading	.230	.464

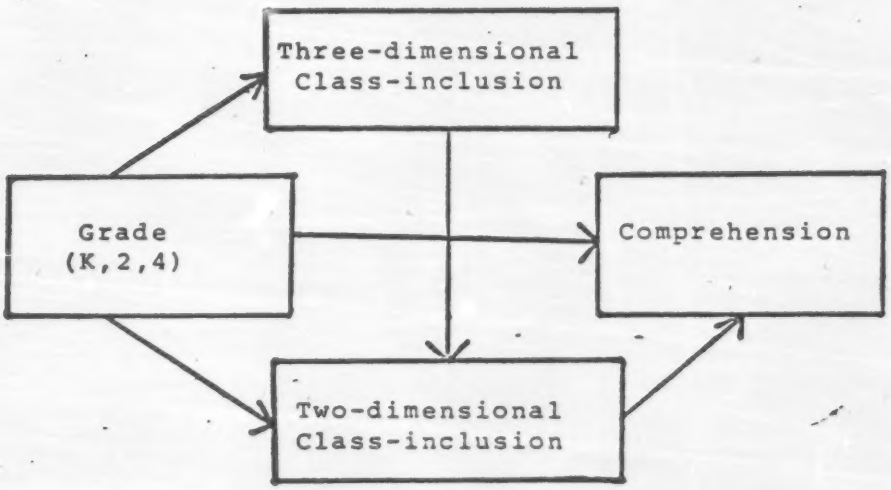

Figure 1: Hypothesized model of the Relations between Grade, Three-dimension Inclusion, Two-dimensional Inclusion and Comprehension

References

Blalock, H. M. (Ed.) Causal models in the social sciences. Chicago: Aldine Press, 1971

Caldwell, P. Perceptual and cognitive processes in reading: Analysis of the construction of a main idea statement. Paper presented Twentieth Annual Convention of the International Reading Association, New York, May, 1975.

Gallagher, J. M., and Reid, D. K. To relate or to discriminate: That is the question. Paper presented at the annual meeting of the Jean Piaget Society. Philadelphia: June, 1975.

Goodman, K. Reading: A psycholinguistic guessing game. In H. Singer and R. Ruddell (Eds.) Theoretical models of the reading process. Newark, Delaware: International Reading Association, 1970.

Hathaway, W. E. The degree, nature and temporal stability of the relations between traditional psychometric and Piagetian developmental measures of mental development. Unpublished dissertation, University of Pennsylvania, 1972.

Inhelder, B., and Piaget, J. The early growth of logic in the child. New York: W.W. Norton & Co. Inc., 1964.

Inhelder, B.; Sinclair, H. and Bovet, M. Learning and the development of cognition. Cambridge, Mass.: Harvard University Press, 1974.

Kerlinger, F., and Pedhazur, E. Multiple regression in behavioral research. New York: Holt Rinehart & Winston, 1973.

Li, C. C. Path analysis - A primer. Pacific Grove, California: Boxwood Press, 1975.

Piaget, J. L'Equilibration de structures cognitives. Paris: Presses Universitaires de France, 1975.

Reid, D. K., and Reiling, A. Toward creative research in reading. Symposium (with J. M. Gallagher, G. Moore and M. A. Pulaski) presented at the annual meeting of the Jean Piaget Society. Philadelphia: June, 1976.

Wilkinson, J. E.; Lunzer, E. A., and Dolan, T. Mini-symposium: Cognitive development--internal and external determinant factors affecting cognitive behavior of children in their first year of schooling. Paper presented at the International Society for the Study of Behavioral Development, Ann Arbor, Michigan, 1973.

Appendix B

Paragraph 1

Today my father baked a cake. First he put the mix into a bowl. Then he put in some milk and one egg and mixed it. After the cake baked for one hour, Dad said it was done.

a. The cake baked for one hour.

b. My father baked a cake today.

c. The cake was very good.

d. Dad used an egg in the cake.

Paragraph 2

Some people read to learn new things. Some people read to find answers to questions. Other people read to have fun. Some people read about new places. People read for many different reasons.

a. People read books just for fun.

b. There are many reasons why people read.

c. A lot of people don't like to read.

d. People read about new places.

Paragraph 3

Trucks are very important to us. They bring food to the stores. They carry animals to the farms. Trucks also bring clothes to the stores. The books in your school came by truck.

a. Trucks are very important to us.

b. Trucks bring animals to the farm.

c. There are many important books.

d. Trucks carry food to the stores.

Paragraph 4

Lucy rowed the boat out into the middle of the lake. She took out the stick, string and hook that she was going to use. She made a fishing pole. At the end of the day she had caught five fish. Lucy had learned to fish all on her own.

a. Lucy made her own fishing pole.

b. Lucy knew how to row a boat.

c. Lucy learned to fish all by herself.

d. Lucy liked to catch very big fish.

Paragraph 5

There were a lot of animals at the pet store. A little chick made funny noises. Ann laughed. A kitten licked Ann's hand. Ann got to hold a little white mouse. She liked her visit to the pet store.

a. A little kitten licked Ann's hand.

b. An wanted to go home from the pet store.

c. A yellow chick made funny noises.

d. Ann liked her trip to the pet store.

Paragraph 6

My room was a mess. I put all my shoes back in the closet. I hung up my clothes. I put all my toys away. Then I put my books in a neat pile. Then Mom came in and smiled.

a. My mom always smiles.

b. I have lots of toys.

c. I cleaned up my room.

d. My shoes were put away.

Paragraph 7

Kathy came home from school. She took out a spoon, a bowl, a knife and a glass. Her mother gave her some soup, some milk and some bread and butter. Kathy ate all her food in ten minutes. Then Kathy ran back to school.

a. Kathy's mother does not like milk.

b. Kathy ate some bread and butter.

c. Kathy came home from school for lunch.

d. Kathy ran back to school.

Paragraph 8

The balloons were red and orange. We all played games. Sammy's mom and dad made the cake. We had fun watching Sammy open his presents. He liked my present the best. It was a baseball.

a. Sammy's mom and dad made the ice cream.

b. The balloons were red and orange.

c. We had a good time at the birthday party.

d. I gave Sammy a baseball for his birthday.

Paragraph 9

There are many things to do in New York City. You can go to the park. You can see animals at the zoo. You can go to see the circus. Riding on the subway train is fun, too.

a. There is a zoo in New York City.

b. You can see the circus in the park.

c. In New York City there are many things to do.

d. It is fun to ride on the subway train.

Appendix C

The following three pages present the correlation matrices generated during the path analysis for each grade level.

Abbreviation Key

CI(O)	Three-dimensional class-inclusion using objects.
CI(P)	Two-dimensional class-inclusion using pictures.
LIST*	Listening Test
MIT(TOT)	Main Idea Test (Total)
MIT(F)	Main Idea Test (First sentence)
MIT(L)	Main Idea Test (Last sentence)
MIT(I)	Main Idea Test (Inferred)
STAN A*	Stanford Achievement Test, Form A
STAN B	Stanford Achievement Test, Form B

*As a courtesy to the schools, additional subtests were given on the Stanford Achievement Test.

Correlation Matrix for Kindergarten Measures[a]

	CI(O)	CI(P)	LIST	MIT(TOT)[b]	MIT(F)[b]	MIT(L)[b]	MIT(I)[b]
CI(O)		.86	.24	.17	.23	.02	.11
CI(P)			.22	.21	.30	.04	.12
LIST				.16	.24	.02	.10
MIT(TOT)					.64	.69	.79
MIT(F)						.08	.32
MIT(L)							.33
MIT(I)							

[a] $\underline{n} = 102$

[b] The MIT was given as a listening test.

Correlation Matrix for First Grade Measures[a]

	CI(O)	CI(P)	LIST*	MIT(TOT)	MIT(F)	MIT(L)	MIT(I)	STAN A*	STAN B
CI(O)		.92	.25	.24	.24	.04	.15	.15	.13
CI(P)			.23	.21	.21	.04	.12	.12	.13
LIST*				.22	.22	.20	.05	.15	.29
MIT(TOT)					.75	.68	.54	.38	.30
MIT(F)						.41	.17	.24	.33
MIT(L)							.06	.28	.26
MIT(I)								.29	.06
STAN A*									.67
STAN B									

[a] $\underline{n}$ = 72

Correlation Matrix for Second Grade Measures[a]

	CI(O)	CI(P)	LIST*	MIT(TOT)	MIT(F)	MIT(L)	MIT(I)	STAN A*	STAN B
CI(O)		.97	.29	.40	.26	.24	.25	.21	.19
CI(P)			.28	.35	.26	.22	.24	.21	.20
LIST*				.44	.23	.38	.33	.51	.54
MIT(TOT)					.67	.71	.70	.42	.42
MIT(F)						.40	.34	.26	.23
MIT(L)							.49	.33	.39
MIT(I)								.32	.26
STAN A*									.74
STAN B									

[a] $\underline{n}$ = 93